

Organic Integrated Pest Management

How to Avoid Problems

Good Pest Management is Based on Healthy Soils

- Healthy soils contain many different organisms that compete with pest organisms, keeping them in check
- Having a variety of flowering plants on the farm provides food — pollen & nectar — and refuge for numerous beneficial insects.



Healthy soils contain many organisms that feed & protect plants.

Maintain the Diversity and Fertility of the Soil

- By using compost
- By planting cover crops and green manures
- By rotating crops in the field

Healthy soil protects and feeds plant roots. The plant on the left grew in better soil.

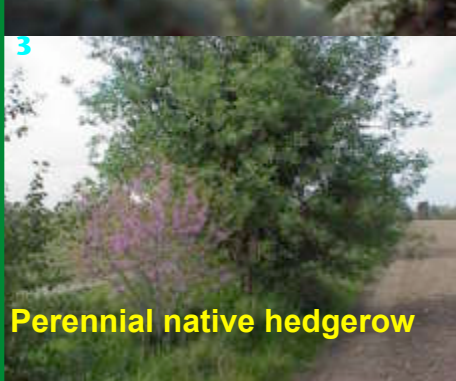


It's Important to Care for the Beneficial Organisms Both Above and Below the Soil Surface.

Keep a diversity of plants in the field to feed and shelter the beneficial organisms that help fight pests.



Tachinid parasitic fly on California buckwheat



Perennial native hedgerow



Flowering annuals in crop rows



Ladybugs overwintering in deergrass



First year perennial hedgerow

2 Providing Habitat for Beneficial Organisms

Keeping a diversity of plants on the farm helps with pest control

Hedgerows and Plant Habitat Provide:

- Habitat for beneficial organisms and wildlife
- Windbreaks to slow erosion
- Dust barriers
- Pesticide barriers between conventional and organic fields
- Protection from soil loss by water erosion

- Food, fruit, nuts, & aromatic herbs
- Beautiful landscape

Flowering annual plants attract beneficial insects

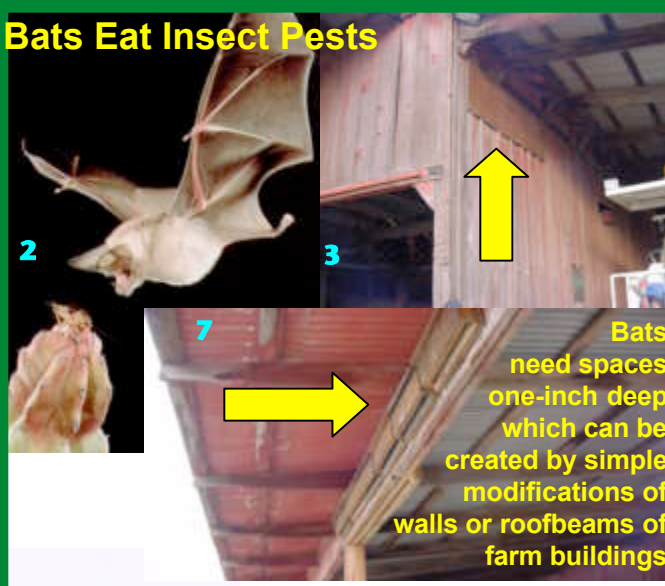


Planted with the crops

Or planted around a water source

- Bats are nocturnal, like the moths (armyworm and cutworm adults) that plague many crops.
- One colony of bats can consume as many as 100,000 insects — such as cucumber beetles and moths— in a single season.

Bats Eat Insect Pests



Bats need spaces one-inch deep which can be created by simple modifications of walls or roofbeams of farm buildings



6 Trees and bushes offer protection from the wind, and perches for birds that eat insect pests

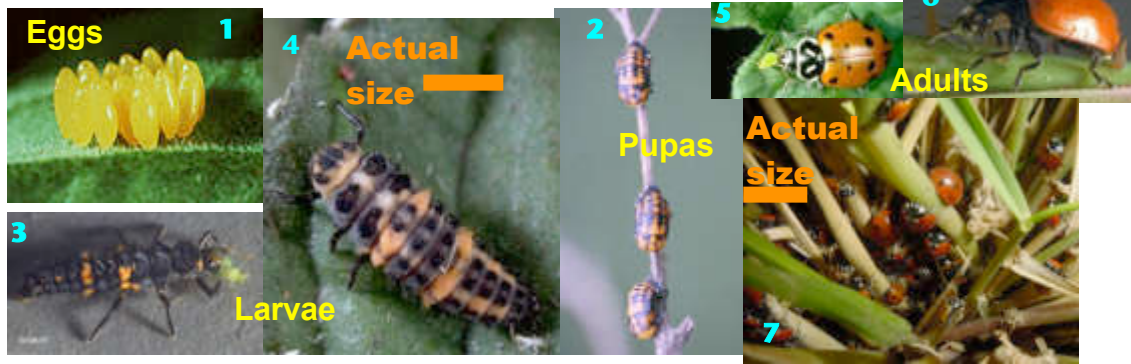
8 Perennial hedgerow



Nest boxes can be made for owls. These night hunters eat many insects and rodents.

Protect these Beneficial Insects that Eat Insect Pests!

Life Cycle of Lady Bugs



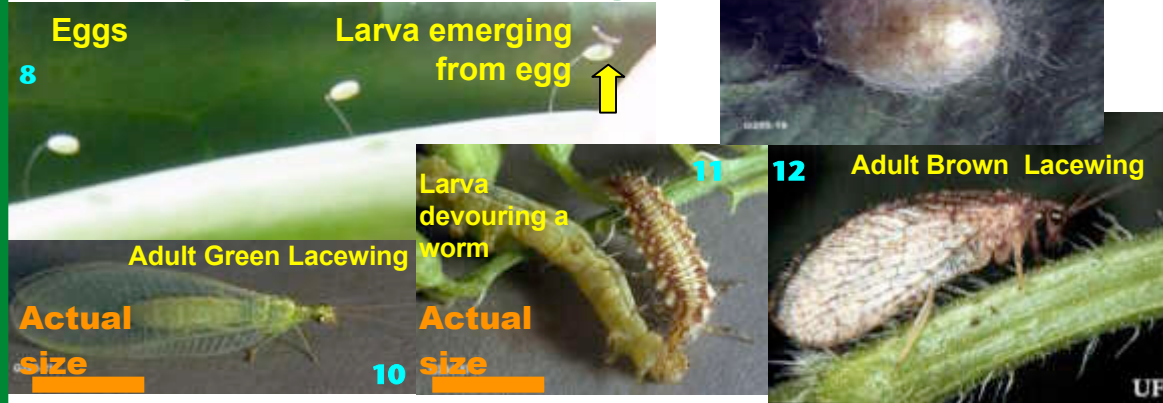
What do they eat?

Larvae & adults eat:
 Aphids
 Mealy bugs
 Mites
 Soft scale
 Eggs of insect pests.

Where do they live?

In plants of the carrot family — fennel, dill, Queen Anne's lace. Also yarrow and sunflowers. Deergrass and other clumping grasses are excellent habitats for overwintering ladybugs.

Life Cycle of Lacewings



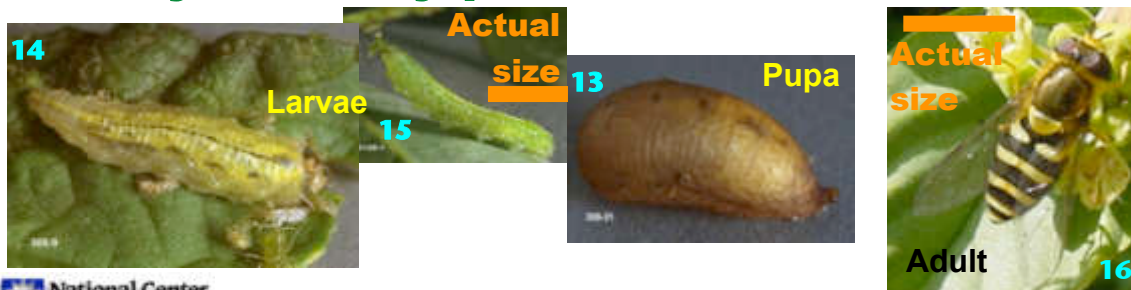
What do they eat?

The larvae eat soft-bodied insects including aphids, thrips, mealy bugs, soft scale, worms, and mites. The adults eat pollen & nectar.

Where do they live?

In plants of the carrot family — fennel, dill, Queen Anne's lace. Also yarrow, sunflowers, buckwheat, California buckwheat, corn, amaranth, holly leaf cherry, alyssum, coyote brush.

Life Cycle of Syrphid Flies



What do they eat?

The larvae eat aphids. The adults eat pollen & nectar.

Where do they live?

In plants of the carrot family— fennel, dill, Queen Anne's lace. Also yarrow, sunflower, buckwheat, alyssum, coyote brush, and other flowering plants.

Protect these Beneficial Insects that Eat Insect Pests!

Life Cycle of Damself Bugs



What do they eat?

- Nymphs & adults eat:
- Aphids
 - Mites
 - Thrips
 - Worms
 - Lygus bugs
 - Leafhoppers

Where do they live?

- Yarrow
- Alfalfa
- Goldenrod
- Plants of the sunflower family.

Life Cycle of Big-Eyed Bugs



What do they eat?

- Nymphs & adults eat many insects including:
- Aphids
 - Mites
 - Thrips
 - Worms
 - Flea beetles
 - Insect eggs

Where do they live?

- Cool season cover crops (berseem clover & subterranean clover) and common knotweed

Tachinid Flies



Trichopode pennipes (Big Foot Fly), a parasite of squash bugs.

What do they eat?

- The larvae parasitize many worms, Japanese beetles, and some bugs.
- Adults eat pollen & nectar.

Where do they live?

- In plants of the carrot family — fennel, dill, Queen Anne's lace.
- Also yarrow, sunflowers, buckwheat, alyssum, coyote brush.

Protect these Beneficial Insects that Eat Insect Pests!

Life Cycle of Pirate Bugs



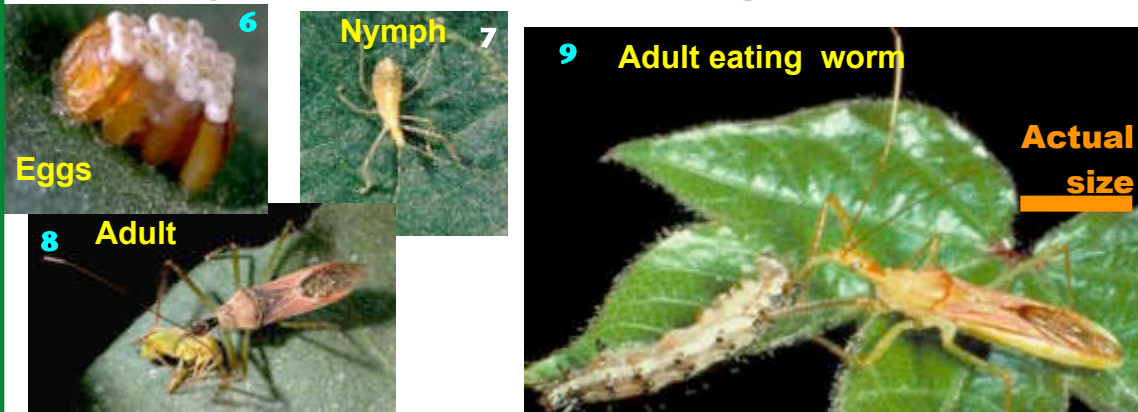
What do they eat?

Nymphs & adults eat:
Thrips
Mites
Leafhoppers
Small worms
Insect eggs

Where do they live?

In plants of the carrot family — fennel, dill, Queen Anne's lace. Also yarrow, sunflowers, buckwheat, alyssum, coyote brush, alfalfa, corn, clover, & vetch.

Life Cycle of Assassin Bugs



What do they eat?

Nymphs & adults eat:
Many insects including large insects and worms

Where do they live?

In permanent plantings such as hedgerows, which provide shelter and food.

Spiders

Jumping Spider



What do they eat?

Spiders eat a great variety of pests, including aphids, flea beetles, cucumber beetles, leafhoppers, & many others.

Where do they live?

One of the best ways to increase the number of spiders is to use straw mulch and maintain undisturbed habitat strips, such as hedgerows.

Important Insect Pests

Why Is It Important to Understand the Life Cycles of Pests?

1. To understand what these insects are like in all phases of their life cycles. Many juveniles do not look at all like the adults and can live in completely different kinds of places.
2. To understand the various stages and forms that these insects take, and to manage the places they live — whether on the undersides of leaves, in the soil, or other locations—to decrease their populations.
3. To manage the insects by varying planting dates, and using trap crops, and sticky traps.

Cucumber Beetles (*Diabrotica sp.*)

Damage Caused by Cucumber Beetles



How to Manage Cucumber Beetles

- Set aside or create habitat for beneficial insects and bats.
- Delay planting to avoid the time when the beetles lay their eggs. (Beware: this could cause you to miss an early marketing window.)
- Use row covers or paper cones to protect the young plants. (Beware: this may interfere with weeding.)
- Thick mulch prevents pest insects from laying their eggs in the soil at the base of the stems.
- Trellis the plants to get them up off the ground.
- Cultivate and eliminate crop residues.
- Monitor the pest populations twice a week when the plants have less than five leaves: Check five plants in five different parts of the field. If you find more than five beetles per plant, some treatment is called for.
- Use trap crops, bait, and sticky traps.
- Consider using protective substances and organically approved insecticides.
- Be aware that the following varieties are extremely susceptible to damage:
 - Zucchini*: all varieties.
 - Other squash*: Cocozelle, Caserta.
 - Butternut Squash*: Early Butternut, Waltham.
 - Buttercup*: Honey Delight, Buttercup Burgess, Ambercup.
 - Pumpkins*: Happy Jack, Big Max, Baby Boo.

These beetles can transmit diseases such as bacterial wilt and mosaic virus of squash



Grow Crops

These Beetles Don't Eat

Try to grow the varieties that are LEAST attractive to cucumber beetles:

Summer Squash

Yellow Squash: Sunbar, Slender Gold
Straightneck: Seneca Prolific, Goldbar.
Crookneck: Yellow Crookneck
Scallop: Peter Pan

Winter Squash

Acorn: Table Ace, Carnival, Table King
Pumpkins: Baby Pam, Munchkin

Preferred Hosts of Cucumber Beetles

Most Susceptible to Damage

Number one is highly susceptible and number seven is least susceptible.

1. Cucumber
2. Cantaloupe
3. Honeydew Melon
4. Casaba Melon
5. Winter Squash
6. Summer Squash
7. Watermelon

Also:

- Corn • Potatoes
- Tomato • Fruit • Beans
- Cabbage • Lettuce



Important Insect Pests

Lygus Bugs

Crops Affected by Lygus

Methods of Controlling Lygus



- Strawberries
- Green Beans
- Cotton
- Lettuce
- Dry Beans
- Alfalfa
- Fruit

- Create habitat for beneficial insects
- Eliminate weeds
- Monitor plantings for beneficial insects
- Plant trap crops (alfalfa & radish)
- Botanical pesticides as a last resort

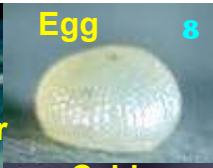


Beneficial Organisms that Attack Lygus

- Fungus: *Beauveria bassiana* (Mycotrol™)
- The parasitic wasps *Anaphes ioles* & *Peristenus sp.*
- Damsel Bugs, Big-Eyed Bugs, Assassin Bugs, Lacewings, Spiders

Caterpillars of Moths & Butterflies

Methods of Controlling Caterpillars



- Create habitat for beneficial predators and parasites
- Bacillus thuringiensis (Bt)
- Botanical pesticides
- Repellents: dilute garlic, onion or chilis with water
- Pheromones



Important Insect Pests

Aphids



Methods of Control

- Create habitat for beneficial insects
- Control ants
- Repellents: Dilute garlic, onion or chilies with water
- Insecticidal soaps
- Diatomaceous earth
- Vegetable oils
- Botanical Insecticides (Neem)
- Physical (water sprays)

Natural Enemies

- Predators such as Lacewings, Syrphid Flies & Ladybugs
- Parasites
- Diseases



Ants tend aphids, harvesting the juice they exude.



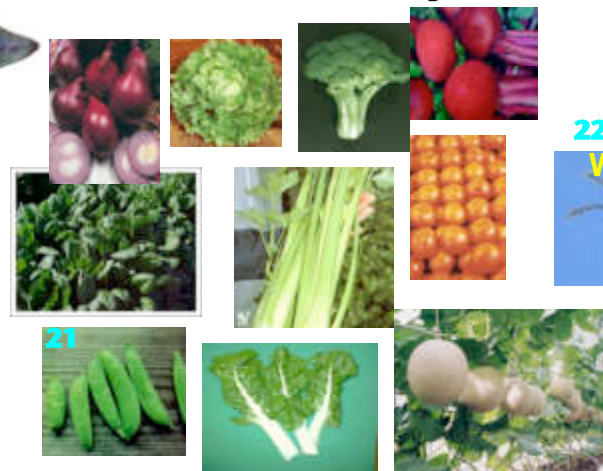
Aphid mummies, showing exit holes of parasitic wasps



Leaf Miners



Some Affected Crops



Methods of Control

- Parasitic wasp (*Diglyphus isaea*)
- Row covers
- Don't plant next to infected crops
- Use botanical pesticides (on adults)
- Use "Neem" (for larvae)
- Sanitation
- Mulches
- Use sticky traps



Important Insect Pests

Mites



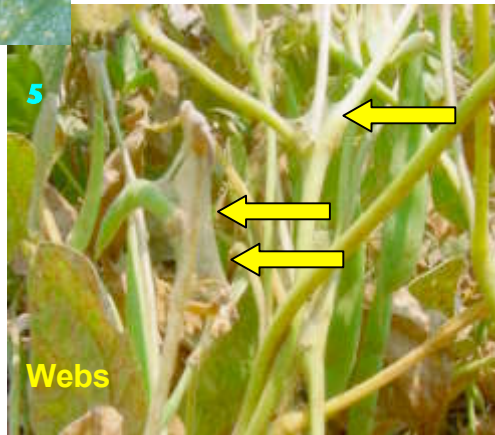
Affected Plants

- More than 300 host plants
- 100s are cultivated crop plants
- Strawberries, cotton, peppers, chiles, tomatoes, tree fruit, & various ornamental plants

Biological Control of Mites



- Beneficial Mites
- Predators:
 - Pirate Bugs & Big-Eyed Bugs
 - Lacewings
 - Thrips
 - Ladybugs



Other Controls for Mites

- Sulfur
- Soaps
- Vegetable Oil
- Citric Acid or Lemon Juice
- Some Botanical Insecticides



Predatory mite attacking spider mite

Cultural Controls for Mites

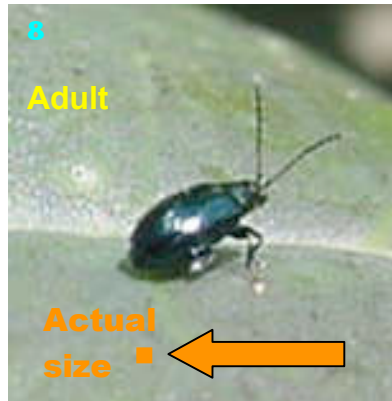
The most important practice: Eliminate dust by...

- Creating hedges and windbreaks between roads and fields
- Using cover crops or mulches and leaving crop residues after harvest
- Wetting down roads
- Giving crops sufficient moisture
- Using sprinkler irrigation
- Planting cover crops

Remember to apply only materials accepted by your certifier!



Flea Beetles



They jump like fleas and chew numerous holes in plant leaves. They can transmit diseases.

Controls

- Row covers
- Beneficial nematodes
- Sticky traps located every 15 to 30 feet along the rows
- Repellents: Dilutions of garlic, onion, or chilies with water
- Botanical Insecticides